THE AMERICAN MINERALOGIST

JOURNAL OF THE MINERALOGICAL SOCIETY OF AMERICA

Vol. 10. DECEMBER, 1925 No. 12

SKELETON QUARTZ CRYSTALS

GEORGE W. BAIN, *Columbia University*

THE OCCURRENCE AND PROBLEM

Quartz phenocrysts of unusual crystal habit were found by the author in rhyolite vitrophyres from Agate Point, forty miles east of Port Arthur on the north shore of Lake Superior. These crystals have three plates of solid quartz intersecting at 60°, whose outward extension from their intersection is terminated by two faces meeting at 120°. The space in between these plates is in part quartz (Figs. 1 and 2) and in part natural rhyolitic glass. Examination of thin sections cut almost perpendicular to the crystallographic *c*-axis showed that the quartz is in crystallographic continuity through the phenocryst. The author has since observed similar skeletons in the bipyramidal quartz crystals found in rhyolites at Deadwood, South Dakota, and at Spring Creek, Colorado.

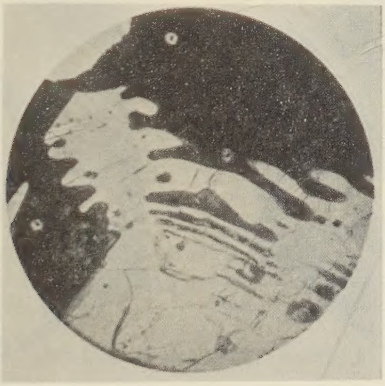

Fig. 1. Photomicrograph of a portion of a skeleton quartz crystal from Agate Point, Lake Superior. Magnification about 17 ×. Ordinary light.

The red vitrophyre (dark) at its contact with the quartz (clear) has a light turbid appearance. This turbid zone consists mainly of microcrystalline mosaic quartz.

Skeleton structures of this type might be formed in a number of ways. Two of the most outstanding are the following: (a) The skeleton is a remnant left after corrosion or partial resorption of a former quartz crystal by the vitrophyre which is replacing it. (b) The skeleton is a growing crystal suspended in liquid vitrophyre magma. This magma is being expelled from the position occupied by the crystal by the force of crystallization.

Structures Due to Resorption

Examples of resorption of both euhedral quartz phenocrysts and of skeleton quartz phenocrysts are very abundant in the Agate Point vitrophyres. An example of a typical partially resorbed quartz grain is shown in Fig. 7. The crystal is invaded by tongue-like masses of magma which show no regular behavior in their method of attack upon grains composed entirely of quartz. Therefore the regularity of the skeleton structure does not appear to be due to partial resorption of a solid quartz phenocryst.

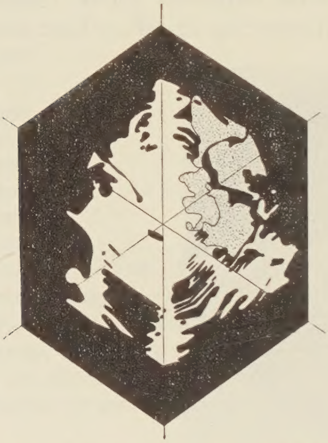

Fig. 2. Skeleton quartz crystal from Agate Pt. Quartz shown in white, vitrophyre in black, and secondary quartz stippled.

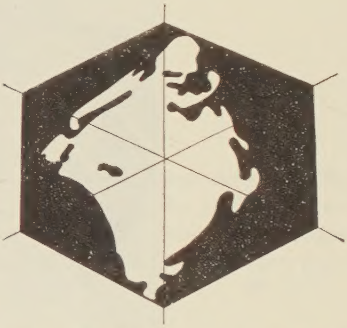

Fig. 3. Skeleton quartz crystal from Agate Pt. The lower left hand portion of the crystal is almost completely resorbed.

Resorption effects of the vitrophyre upon skeleton crystals are shown in Figs. 2, 3, 4, and 5. For example, in Fig. 2, resorption has removed a large part of the upper right hand and upper left hand parts of the crystal and yet left the remaining parts unchanged. In this case skeleton residuals do not remain but the corroding vitrophyre has removed everything to its outer limits. Fig. 3 shows a skeleton partly resorbed, but enough "ribs" still remain to identify the position of the three intersecting plates of quartz. In this case, as well as in Fig. 2, resorption is complete to its outward limit. The process left no quartz residuals.

Fig. 4 shows a further stage in resorption of a quartz skeleton crystal. One plate and part of another is well preserved. The other parts of the quartz, however, have been dissolved in the magma solution. Fig. 5 shows a still further stage in the destruction of a crystal; only small parts adjacent to two plates remain, and of these remnants only the outer ends are preserved.

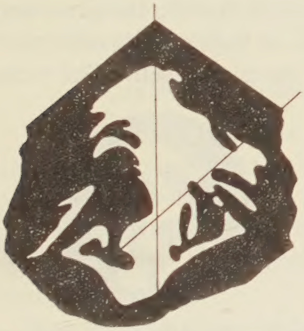

Fig. 4. Skeleton quartz crystal from Agate Pt. completely resorbed, except or half of two axial plates.

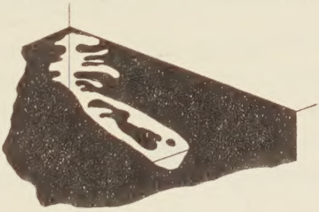

Fig. 5. Skeleton quartz crystal from Agate Pt. showing almost complete resorption. Only the ends of the axial plates are left.

Conclusions Regarding Resorption

It appears that when resorption of quartz crystals occurs, the process is complete up to the edge of the corroding solution. Corrosion at the centre may be complete before parts of the outside are even affected. No regular systematic arrangement of corroding tongues such as that shown in Fig. 2 can be found in the pure crystals. Even when the corroding magma attacks a skeleton crystal it removes both quartz and included glass entirely, instead of following narrow zones analogous to the glass separating the ribs of the skeleton crystal.

The Skeleton Structures

The most complete skeleton crystal found in the Agate Point vitrophyres is shown in Fig. 2, and a portion of the same phenocryst is reproduced in the photomicrograph shown in Fig. 1. The crystal exhibits three plates from which glass is completely absent, composed of quartz having the same crystallographic orientation. Slender plates of quartz, crystallographically continuous with the first and separated from one another by glass, play the part of supporting crossbars. The separating glass films become thinner towards the interior of the crystal and disappear before the centre is reached.

A section of this crystal cut almost perpendicular to the vertical axis was examined under the microscope with nicols crossed and it was found that the light, turbid areas surrounding the glass and occurring in it (Fig. 1) are composed of microcrystalline mosaic quartz. Thin films of mosaic quartz, having the same shape as the glass films found near the edge of the crystal, continue in toward the centre much farther than the glass itself. The mosaic of the films near the centre of the phenocryst is more coarsely crystalline than where it is associated with the natural glass and furthermore, the reorganized borders of the films are in crystal continuity with the main mass of the phenocryst. The microcrystalline quartz is clearly reorganized rock glass from which the impurities have been removed. The purified product thus formed was being recrystallized with the same orientation as that in the main part of the phenocryst.

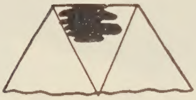

Fig. 6. Section of bipyramidal quartz crystal isolated from a rhyolite vitrophyre found at Spring Creek, Colorado. The crystal shows almost complete growth and exclusion of magma.

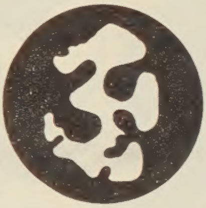

Fig. 7. Normal quartz phenocryst from Agate Pt. vitrophyre which has attained growth and complete exclusion of magma but which has been resorbed at a later stage.

A number of bipyramidal quartz crystals from salic extrusives of other localities were examined. Exceptionally good skeleton crystals from which the glass had been almost completely expelled were found in the rhyolites from Deadwood, South Dakota, and from Spring Creek, Colorado. These crystals exhibited the relations of the three intersecting plates to the crystal form of the quartz unusually well. A section of a crystal from Spring Creek, Colorado, is shown in Fig. 6. And it will be observed that the plates of pure quartz emerge at the corners and that the planes about which the individual films of glass are symmetrical are parallel to the crystal faces. A suggestion of this relationship is shown in Fig. 1.

SUMMARY OF SKELETON STRUCTURES

The films of glass are parallel with the crystal faces and the planes of clear quartz emerge at the corners. At the time of the growth of the crystal the glass was being replaced by mosaic quartz which was recrystallizing in crystal continuity with the three plates emerging at the corners.

THEORY OF FORMATION OF SKELETON CRYSTALS

It has been shown that when resorption of the quartz crystals occurs, the magma completely dissolves a mass of the crystal or develops grotesque forms as in Fig. 7, instead of selecting a few narrow definitely located zones in it. The theory that the skeleton crystals are due to resorption phenomena, therefore, appears to be untenable.

Mosaic quartz has been shown to have been replacing the rock glass at the time of formation of the phenocrysts. It has also been pointed out that this mosaic was recrystallizing in crystal continuity with the three intersecting plates emerging at the six edges of the crystal. The central or pure portion of the phenocryst, therefore, is a skeleton purified by recrystallization and removal of impurities.

Crystal growth started from three "axial" plates which probably indicate three directions of greatest molecular attraction for quartz. Lateral growth from one plane to another proceeded along zones of greatest molecular attraction or zones of shortest distance between corresponding points on adjacent primary planes. Certain secondary supporting plates seem to have had more favorable conditions for growth than others, so that they sealed off portions of the magma (now glass) from the remainder in which the phenocrysts were suspended. These segregated portions have been largely purified by recrystallization and replacement and, doubtless, had the magma not been chilled to form a vitrophyre, would have been completely replaced. Resorption attacks the outside of the crystals first so that this process also helped in the removal of the glass occurring chiefly on the outer parts of the phenocrysts.

MINOR SECONDARY STRUCTURES

It might be expected that the areas of quartz should have sharp outlines comparable to those in snow crystals described by Bentley,[1] and Whitlock.[2] Careful consideration of the conditions will show that this is not necessary. For example, it is known that surface tension increases with viscosity. The viscosity of water saturated air (the magma in which the snow crystals formed) is almost zero, whereas the viscosity of the much higher specific gravity vitrophyre (magma in which the skeleton quartz crystals grew) is very high by comparison. The surface tension in the vitrophyre magma, therefore, would exert a counteracting force upon crystal growth (which was not encountered by the growing snow crystals) and quartz would separate out from the magma solution only where the force of crystallization was greater than the force due to surface tension. Liquids tend to form curved meniscus films, that is, the surface energy of the liquid is exerted to maintain a curved surface, when contained between walls. The surface of the vitrophyre magma in the films would, therefore, be determined by the equilibrium surface between the force of crystallization of the quartz and the surface energy of the liquid magma. This equilibrium surface would be curved somewhat after the fashion shown in the figures.

Figs. 2 and 4 show the ribs joining adjacent plates of quartz somewhat bent. This is probably due to deformation of the crystal at the time it was growing, rather than to a primary three-fold symmetry as suggested by the recurrence of the structure on alternate faces, as shown in Fig. 2.

ETCHING

Polished surfaces parallel to the base of pure bipyramidal quartz crystals from Spring Creek, Colorado, were prepared and gently etched with hydrofluoric acid. These surfaces showed that the planes joining the opposite edges resisted attack better than any other part of the crystal and the entire surface gave a suggestion of the primary shape shown in Fig. 2. The tests were not conclusive, but suggested that the quartz molecule had a very much greater attraction for other quartz molecules along certain planes than others.

---

[1] Bentley, W. A.: Studies of Frost and Ice Crystals. *United States Monthly Weather Review*, **35**, 1903.

[2] Whitlock, H. P.: The Mimicry of Crystals. *Natural History*, **XXV**, 156-161 (1925).

CONCLUSIONS

Primary skeleton quartz crystals seem to show that the quartz molecule has a greater attraction along three lines at 60° to one another than in any other direction.

Etch figures on polished surfaces of pure bipyramidal quartz crystals from Spring Creek, Colorado, seem to show the same molecular attractions within the quartz as do the skeleton crystals.

These lines of greatest molecular attraction correspond to the usual crystallographic axes and it would seem that these hypothetical axes express the directions of greatest molecular attraction.

TOPAZ AND ASSOCIATED MINERALS FROM THE EINSTEIN SILVER MINE, MADISON COUNTY, MISSOURI[1]

CLARENCE S. ROSS AND E. P. HENDERSON

INTRODUCTION

The Einstein Silver Mine of southeastern Missouri was visited by one of the writers (Clarence S. Ross) in company with Dr. W. S. Bayley and several graduate students in geology from the University of Illinois in the spring of 1917. The old Einstein Silver Mine, which is located on the banks of the St. Francois River, nine miles west of Fredericktown, Madison County, Missouri, contains a group of minerals unknown elsewhere in the Mississippi valley region.

The following notes on the mine are given by Buehler[2]:

> "Systematic prospecting was begun in 1877 and as a result a quartz vein was opened. . . . . After producing fifty tons of lead and three thousand ounces of silver

---

[1] Published by permission of the Director of the U. S. Geological Survey.

[2] Buehler, H. A., Biannual report of the State Geologist of Missouri, pp. 97, 98 (1919).

the property was shut down. . . . . The Einstein Mine is located near the southern end of the granite area which extends southward from Doe Run for a distance of about fifteen miles. The country rock is a coarse grained red granite which is cut by diabase dikes and veins of quartz. . . . . Three distinct veins of quartz have been opened up and developments started on four others. The veins vary from a few inches to five feet in width, the average being about two feet. . . . .

"The locality is unique in furnishing a number of minerals found nowhere else in the State. Tungsten in the form of hübnerite is scattered through the quartz from the size of a pin head to massive bunches weighing one hundred pounds. Pyrite and a dark lithia mica (zinnwaldite) usually appear where the hübnerite is bunched."

In 1888 Erasmus Haworth published a paper entitled "A Ccntribution to the Archean Geology of Missouri,"[3] in which topaz and its associated minerals are admirably described as follows:

". . . . The vein itself was filled with quartz, argentiferous galena, fluorite, lepidolite (more correctly described as zinnwaldite), wolframite, and probably other minerals. The wall-rock was originally granite. At present, however, it consists of quartz imbedded in a fine-grained mixture of mica scales and traces of iron oxide, leucoxene, beautiful little zircon crystals and probably other materials. Scattered through this mass in varying proportions are the minerals fluorite and topaz.

We evidently have here the results of a fumerole action, recalling in some respects the conditions around the tin mines of Cornwall, England, of Zinnwald in Bohemia, and those of other places. The resemblances consist in the granite wall-rock being decomposed for a few feet on each side of the vein, and the occurrence of topaz, wolframite, lepidolite and fluorite, minerals which are associated with tin ores in other places. But so far as now known there is a total absence of cassiterite, as well as of tourmaline, and other minerals—excepting those just given—which always accompany tin deposits.

Topaz.—In all the thin sections examined from the wall-rock of the vein just described a considerable quantity of a mineral thought to be topaz was found. It does not have a regular crystalline form, but in many cases the direction of the crystallographic axes could be determined. Its index of refraction, as shown by its apparent thickness, its parallel extinction, and its polarization colors strongly implied that the mineral in question was topaz. . . . A blow-pipe examination with the salt of phosphorus proved it to be a silicate. There can be little doubt, therefore, that the mineral is topaz."

Recently some of the specimens secured in 1917 were reexamined and one of them was found to contain an abundance of a fine-grained mineral that had the optical properties of topaz. As it is not generally known that topaz occurs in this region, it seemed wise to definitely establish the identity of the material, and so it was analyzed by the junior author (E. P. Henderson).

---

[3] Haworth, Erasmus, *Am. Geol.*, **1**, 295 (1888).

OCCURRENCE AND ASSOCIATED MINERALS

The minerals that have been reported from the vein itself are quartz, fluorite, argentiferous galena, pyrite, sphalerite, hübnerite and scheelite,[4] the latter intimately intergrown with hübnerite. The wall rock on either side of the vein has been profoundly altered and the minerals topaz, quartz, fluorite, argentiferous galena, pyrite, sphalerite, hübnerite and scheelite have developed through the replacement of granite.

The feldspar in the granite of the wall rock has been completely replaced by muscovite and the quartz partly replaced so that isolated island-like areas are all that remain of large quartz crystals. The fluorite (variety chlorophane) is colorless to blue, and on heating glows with a green color that soon changes to purple.

PHYSICAL AND CHEMICAL PROPERTIES

PARTIAL ANALYSIS OF TOPAZ FROM EINSTEIN MINE, TOPAZ OF IDEAL COMPOSITION, AND TOPAZ FROM TRUMBULL, CONN.

	A	B	C
SiO_2	32.65	33.3	32.38
Al_2O_3	54.67	56.5	55.32
Fe_2O_3	1.78	——	——
F	n.d.	17.6	16.2
Total	89.10	107.4[a]	104.82[a]

[a] Deduct oxygen equivalent of the fluorine (= 6 to 7 per cent).

A. Topaz from Einstein Mine, nine miles west of Fredericktown, Mo. E. P Henderson, analyst.

B. Ideal composition of topaz, with aluminum given as oxide.

C. Topaz from Trumbull, Conn.[5]

Fluorine was not determined quantitatively but was found to be present in quantity as an essential part of the mineral.

The topaz has the following optical properties. The indices of refraction are $\alpha = 1.609$, $\beta = 1.614$, $\gamma = 1.618$; $\alpha - \gamma = 0.09$, optical character (+), $2V = 66°$, $2E = 120°$, $\rho > \nu$.

---

[4] Hess, Frank L., Personal communication. Material collected by Ross, examined by Hess.

[5] Dana, System of Mineralogy, p. 495.

THE SO-CALLED GENTHITE FROM WEBSTER, NORTH CAROLINA[1]

CLARENCE S. ROSS, *U. S. Geological Survey,*
AND
EARL V. SHANNON, *U. S. National Museum*

The material described in the following brief note was collected recently by the senior author and seemed of sufficient interest to deserve investigation since it constitutes the principal nickel-bearing mineral of the so-called nickel mine near Webster, N. C. The mineral has been called genthite but the results of the present study indicate that it might more appropriately be called nickeliferous deweylite, although it has a crystalline metacolloidal structure whereas deweylite is supposed to be amorphous.

The mineral is from the well-known Webster dunite area that has been described by Pratt and Lewis in their paper on "Corundum and peridotite of western North Carolina."[2] It was collected about a quarter of a mile south of the Tuckasegee River and one mile west of Webster, Cowee quadrangle, North Carolina, where the dunite has been prospected for nickel.

The mineral occurs in partly altered dunite where it forms numerous films and veinlets a few millimeters wide and a few that reach a maximum width of 4 centimeters.

It is associated with a plastic micaceous mineral of pale green color and with siliceous sinter that has been precipitated in cracks in the dunite. This micaceous mineral will be investigated immediately and the results presented in a subsequent article.

The sample that was used in the analysis and on which the optical properties were determined was one of the largest and purest specimens secured. It has a conchoidal fracture and a faintly waxy luster. The color is apple green (variscite green of the Ridgway standard). A study in thin section shows that the mineral exhibits in remarkable perfection the structure that is commonly believed to indicate a metacolloidal origin. Other thin sections show that many of the film-like masses filling joint cracks in the dunite are composed of complex aggregates of chalcedonic quartz and nickeliferous deweylite. Often the quartz is greatly predominant even when the aggregate is deep apple green in color. It is interesting to note that both these minerals have a metacolloidal structure. The nickeliferous deweylite is completely birefracting with a fibrous structure resembling some banded chalcedony, with the fibers forming parallel and radial groups. The mineral was formed in more than one stage, for several groups of veinlets of the same material cut the earlier formed material at various angles.

---

[1] Published by permission of the Director of the U. S. Geological Survey and the Secretary of the Smithsonian Institution.

[2] Pratt, Joseph Hyde; Lewis, J. Volney: N. C. Geol. Survey, Vol. **I**, pp. 92-95 (1905).

The mean index of refraction is 1.510 with a variation from 1.505 to 1.525. The birefringence is about 0.01, the optical character is (+) and the character of the elongation is (+). The mineral appears to be uniaxial but the structure does not permit an exact determination.

The analysis, made by standard methods upon a sample of ample size, gave the following results:

Analysis of Nickeliferous Deweylite

(E. V. Shannon, Analyst)

	Per cent
SiO_2	43.26
Al_2O_3 and Fe_2O_3	1.20
CaO	0.24
MgO	30.00
NiO	4.20
H_2O+	10.54
H_2O-	9.30
Total	98.74

The analysis shows that the mineral does not approximate the composition usually given for genthite. The water content separates it from serpentine and assigns it to deweylite. It is planned to examine several additional deweylites and to present the results together with a description of the so-called garnierite of Riddle, Oregon, in a paper which will shortly be published.

BOOK REVIEWS

THE NATURAL HISTORY OF CRYSTALS. A. E. H. Tutton. XII+287 pages. E. P. Dutton & Co., *New York*; Kegan Paul, Trench, Trubner & Co., Ltd., *London*, 1924.

This work represents a revised and somewhat enlarged edition of the author's former book "Crystals" which appeared in 1911. Some of the chapters are the same as in the earlier volume. The progress that has been made since the appearance of the earlier text, especially in the field of X-ray analysis and crystal structure, has necessitated the introduction of considerable new material. Chapters on "The Nature of Atoms" and "The Revelation of Crystal Structure by X-Rays" have been introduced in order to bring the book up-to-date, that is, to the date of publication, November 1923. The work as it now stands comprises 21 chapters and 166 illustrations as compared with 17 chapters and 120 illustrations of the former text. An excellent glossary describing over eighty technical terms has been added.

The book states that the text "is intended for the general reader more or less interested in natural science." It is extremely doubtful if this work could serve in that capacity as the treatment is often quite technical and the style, at times, involved. The book can serve to advantage as collateral reading for students pursuing more or less advanced work in crystallography. The numerous illustrations are excellent and well chosen.

The work in general is, without doubt, a contribution to crystallography, marred however by constant personal references throughout the text. As many as seven references to the "author" were found on a single page (p. 129) and no less than a total of ninety references to the "author's investigations," "exhibitions," "lectures," "apparatus," or "collections" were noted by the reviewer.

W. F. H.

GEMS AND GEM MATERIALS. Edward Henry Kraus and Edward Fuller Holden. 222 pages and 256 figures. McGraw-Hill Book Co., *New York*, 1925.

This text is based largely upon a regular course of lectures given for a number of years in the Department of Mineralogy at the University of Michigan. It was written in order to bring the content of these lectures to the attention of the general public and especially to those engaged in the sale of gems and gem materials.

The subject matter falls into two major divisions. Part I, comprising 104 pages, discusses those properties of gems which are necessary for an understanding of the descriptive portion that follows in Part II. In this division the crystallographic, physical and optical properties are described in a clear but non-technical manner. Also short chapters are introduced on the occurrence, cutting and polishing of gems, with sixteen pages devoted to "manufactured stones."

Part II is largely descriptive. Here are to be found descriptions of the precious stones, followed by those designated as semi-precious and these in turn by metallic gem minerals, ornamental stones and organic gem materials, such as pearl, coral, amber and jet. The second part closes with eleven conveniently arranged tables where gem materials are classified according to such properties as crystal form, hardness, specific gravity, color, optical character, index of refraction, dispersion etc.

The book is up-to-date containing numerous cuts not generally found in a text of this type. The photographs are clearly recorded on the good quality of paper selected and very few typographical errors were noted. The clear style of presentation, the numerous illustrations and the popular interest in this phase of mineralogy should all combine to create a demand for this handy volume. W. F. H.

NOTES AND NEWS

Virgil W. Field, a charter member of the Mineralogical Society of America, died at his home in Salt Lake City, Utah, August 14, at the age of fifty years.

Mr. Field died leaving a collection of two thousand specimens which he had been gathering since 1888. His first interest in mineralogy was awakened when a mere lad by a descent into a cave in the famous Hot Pots region, Midway, Utah. From that time on he pursued his study of mineralogy diligently, striving against tremendous odds, as his knowledge of minerals was acquired through his own efforts after his daily carpentry work had been finished.

Shortly before his death Mr. Field had housed his collection in a special laboratory at his home and had finished a complete catalogue of his specimens. It was his desire to have his collection moved to a place of learning, there to be used for educational and display purposes.

NEW MINERALS: NEW SPECIES

CLASS: SILICATES.

Afwillite.

John Parry and F. E. Wright: Afwillite, a new hydrous calcium silicate, from Dutoitspan Mine, Kimberly, South Africa. *Mineralog. Mag.*, **20,** 277 (1925).

Name: In honor of Alpheus F. Williams, General Manager of the De Beers Consolidated Mines, Kimberly, South Africa.

Chemical Properties: A hydrous silicate of calcium. Formula: $3CaO.2SiO_2.3H_2O$. Several analyses are given. One by H. S. Washington, as follows: SiO_2 35.10, Al_2O_3, Fe_2O_3 0.05, MgO 0.02, CaO 49.00, BaO none, $H_2O+110°$ 15.81, $H_2O-110°$ 0.01; sum 99.99. Soluble in hydrochloric acid.

Crystallographic Properties: Monoclinic. $a : b : c = 2.097 : 1 : 2.381$. $\beta = 98°26'$. $p_0 = 1.135$, $q_0 = 2.355$, $\mu = 81°34'$. Crystals prismatic elongated parallel to the b axis. Forms: (001), (100), (110), (310), (102), (101), $(\bar{1}02)$ and a number of doubtful ones.

Physical and Optical Properties: Color white or colorless. Luster vitreous; cleavage basal, perfect; orthopinacoidal, imperfect. Fracture conchoidal. Biaxial positive, $2V_{Na} = 54°40'$. $\alpha = 1.6169$, $\beta = 1.6204$, $\gamma = 1.6336$. $b = Y$, $X \wedge c = 30.6°$. Plane of the optic axes $\perp$ to the elongation of the crystals. Dispersion inclined. H=4. Sp. Gr. 2.630.

Occurrence: Found in a large dolerite inclusion in the kimberlite at the Dutoitspan Mine, Kimberly, associated with apophyllite, calcite and natrolite in crystals up to 11 cm in length. W. F. Foshag.

Kossmatite

O. H. Erdmannsdöffer: Über Kossmatite, ein neues Glied der Sprödglimmergruppe und seine Paragenese. (Kossmatite, a new member of the brittle mica group and its paragenesis.). *Centr. Min. Geol.*, p. 69, (**1925**).

Name: In honor of the geologist, Fr. *Kossmat.*

Chemical Properties: A hydrous silicate of magnesia and alumina. Formula: $H_{18}Mg_3Ca_7Al_6Si_7O_{42}F$. Analysis (by Werner Fisher): SiO_2 28.47, TiO_2tr., Al_2O_3 22.84, Fe_2O_3 0.26, MgO 8.16, CaO 27.10, Na_2O 0.51, K_2O 0.07, P_2O_5 0.04, F 1.14, H_2O+ 11.69, H_2O- 0.82; sum 101.10.
Fusible to a white blebby glass.

Physical and Optical Properties: Colorless, luster vitreous to pearly. Cleavage basal, eminent, not elastic. $2E_{Na}=14° 15'$. $\alpha=1.560$. $\beta-\alpha=.004$.

Occurrence: Found as colorless scales in limestone near Prilep, West Macedonia, associated with corundum, pyrite, and another brittle mica.

Discussion: This mineral is quite different in its ratios from the other members of the brittle mica group and can well be classed as a new member of this group.

W. F. F.

NEW DATA

CLASS: PHOSPHATES, ETC.

Merrillite.

Original Description: E. T. Wherry, *Am. Min.*, **2**, 119 (1917).

New Data: Earl V. Shannon and E. S. Larsen, *Am. Jour. Sci.*, **9**, 250, (1925).

Chemical Properties: A calcium sodium phosphate. Formula: $3CaO. Na_2O. P_2O_5$. Analysis (on .0702 gm. material): Insol. 6.69, CaO 43.45, Na_2O 14.67, P_2O_5 36.47, Cl 0.85, MgO tr, F none, CO_2 none; sum 102.13.

Optical and Physical Properties: Uniaxial, negative. $\omega=1.623$, $\epsilon=1.620$. Sp. Gr. 3.10.

W. F. F.

CLASS: SILICATES.

Iddingsite.

Original Description: A. C. Lawson, *Univ. of Calif. Bull. Dept. Geol.*, No. **1**, p. 31 (1893).

New Data: Clarence S. Ross and Earl V. Shannon, *Proc. U.S. Nat'l. Museum*, **67**, 1 (1925).

Chemical Properties: A hydrous silicate of ferric iron and magnesia. Formula: $MgO. Fe_2O_3. 3SiO_2. 4H_2O$. Analyses of nine different samples given. Average composition from five crystalline samples: SiO_2 39.11, TiO_2 0.18, Al_2O_3 3.29, Fe_2O_3 31.49, FeO 0.96, CaO 2.28, MgO 8.05, H_2O+ 8.49, H_2O- 7.78; sum 101.63.

Optical and Physical Properties: Color pale to deep reddish brown. Pleochroic. Biaxial, generally negative but sometimes positive. $2V$ varies from medium small to large. Dispersion strong, $\rho<\nu$. Indices of refraction variable. $\alpha=1.608$-1.730, $\beta=1.650$-1.725, $\gamma=1.655$-1.765. Cleavage perfect, (100), (001), (010), (101). $X=a$. $Y=b$, $Z=c$. H. about 3. Optical data is given in detail for 8 localities.

W. F. F.

CORRECTIONS TO VOLUME 10

No. 1, p. 5, line 5 from bottom, for "erystalline" read "crystalline."
p. 10, line 1 of footnote, for "chlorophoenecite" read "chlorophoenicite"
p. 18, line 20, for "Leipersville" read "Leiperville" and for "Robinson" read "Robeson."
p. 21, second abstract, for "Luckmanier" read "Lukmanier."
No. 2, p. 40, line 10, for "purlish" read "purplish."
p. 44, line 5 of abstracts, for "lenticulat" read "lenticular."
No. 3, p. 65, line 2, after "into" insert "two."
p 67, line 18, for "ullmanite" read "ullmannite."
No. 4, p. 87, line 1, for "wih" read "with."
No. 5, p. 133, line 8, for "Ni_2S" read "NiS_2."
p. 134, line 1 and 5, for "ferrisymplessite" read "ferrisymplesite."
p. 136, seventh note, for "Walter Gossner," read "B. Gossner."
No. 6, p. 139, line 17, replace formula given by "$5MgO.2B_2O_3.\ 1\frac{1}{2}H_2O$."
p. 140, line 13 from bottom, for "dioxides" read "1:1 oxides."
p. 150, below diagram, for "A_9" read "Aq"; for "Mo/" read "Mol."
p. 151, line 8, for "chabalite" read "chabazite."
p. 152, line 2 of second article, for "siliclous" read "siliceous."
No. 7, p. 162, line 9, for "λ" read "γ."
p. 178, line 12 from bottom, for "Boyl" read "Boyle."
No. 8, p. 195, line 17 from bottom, for "minera" read "mineral."
p. 200, line 14 from bottom, for "Newton" read "Newtown."
No. 9, p. 212, line 4 from bottom, for "pregmatite," read "pegmatite."
p. 236, in table IX, for "ZrO" read "ZrO_2."
p. 254, line 13 from bottom, for "geogical" read "geological."
p. 263, line 12, for "anomolous" read "anomalous."
p. 281, line 9 and 13 from bottom, for "analagous," read "analogous."
p. 297, line 4 from bottom, for "Co_2As_3" read "Co_2As_5."
p. 318, line 7, for "leminiscate" read "lemniscate"; same p. 321, line 6.
p. 334, line 15 from bottom, for "As_2O" read "As_2O_5."
p. 343, first tabulation, line 4, for "0.0602" read "0.0620"; and for "0.97" read "0.99."
line 6, for "1.01" read "1.00."
line 7, for "0.0622" read "0.0625."
No. 10, p. 351, line 7 from bottom, for "C. Flink," read "G. Flink."
p. 354, line 6 from bottom, for "Jolly" read "Joly."

INDEX TO VOLUME 10

Original articles are in **bold face type**; abstracts and cross references are in ordinary type. To save space only minerals described in more or less detail are indexed; titles of abstracted articles are not cross-indexed under authors' names.

Afwillite (Parry, Wright)........ 447
Allopalladium, Brit. Guiana. (Spencer).................. 202
Aluminum silicates (Wherry)...65, 140
Aminoff, G.................... 40
Amphiboles, monoclinic. (Winchell)...................... 335
Amygdaloid, tubular; N. S. (Walker, Parsons)........... 22
Anauxite (Dittler, Hibsch)....... 201
Andalusite, cyanite, sillimanite at high temp. (Peck)........... 253
Antlerite, Chile. (Audrieth, Martens).................. 161
Audrieth, L. F. (with Martens) Antlerite, Chile............. 161

Babingtonite; Japan (Watanabé). 22
Bain, G. B. Skeleton quartz...... 435
Baklund, O. O.................. 20
Bardolite (Morozewicz)......... 134
Barettite (D'Ambrosio)......... 201
Barite in Genesee shale (Martens)....................... 102
Barthoux, J.................... 334
Bauxite with siderite (Burchard).. 44
Beaumontite, (Shannon)........ 31
Benjaminite (Shannon)......... 334
Bentonite, one-dimensional colloid. (Wherry)............65, 120
Bentonite and Montmorillonite. (Ross, Shannon)............ 64
Berek, M. Mikroskopische Mineralbestimmung mit Hilfe der Universaldrehtischmethoden. [Book review.].............. 105
Berman, H. Dachiardite......... 421
——— Lehnerite and ludlamite.. 428
Bohemian minerals.............20, 21
Borgstroemite (Saxén).......... 180
Bourne, C. L. C................. 333
Bragg, W. H. and W. L. X-rays and Crystal Structure. [Book review].................... 156
Brauns, R. Die Mineralien der Niederrheinschen Vulkangebiete. [Book review.]........ 199
Brauns, Adele and R............ 202
Buddington, A. F............... 433
Burchard, E. F................. 44

Cabeen, C. K. See Kerr, P. F..... 66
Calcified log from W. Va. (Fettke)........................67, 109
Calcite xls; North Wales (Mountain)................ 202
——— primary, in igneous rocks (Walker, Parsons)........... 67
Camsellite; California (Eakle)...65, 100
Catalonian minerals (Tomás).... 21
Chabazite..................... 145
Chalcoalumite, (Larsen, Vassar).. 79
Chapmanite (Walker)........... 41
Chlorophoenicite (Foshag, Gage). 39
Chondrodite; Vesuvius. (Jezek). 20
Chrysocolla, radioactive (Puxeddu, Manca).............. 135
Citrine, light transmission (Holden)................... 127
Clerici solution for mineral separation (Vassar)............. 123
Cobaltpyrite (Johansson)........ 180
Color of smoky quartz and amethyst (Holden).............. 203
Crystals and the fine-structure of matter (Rinne). [Book review] 104
Crystal structure of metallic sulfides (Ramsdell)...........67, 281
Crystule (Keyes)................ 15
Cyanite....................... 253

Dachiardite (Berman) 421

D'Ambrosio, A. 108, 201

Danburite; Mexico (Kupferbürger) 14

Davy, M. 133

del Pan, J. 21

Diopside; Canadian (Walker, Parsons) 22

Diopside, space group (Wyckoff, Merwin) 67

Diopside-like pyroxenes, x-ray diffraction of. (Wyckoff, Merwin, Washington) 67

Dittler, E. and Hibsch, J. E. 201

Dumontite (Schoep) 131

Dussertite (Barthoux) 334

Eakle, A. S. Camsellite from Cal. 65, 100

——— **Foshagite, a new Ca silicate** 66, 97

——— Thaumasite, crystn. of 66

Ectropite and bementite, (Larsen). 418

Electrical conductivity of ore minerals (Kerr, Cabeen) 66

Errite (Jakob) 107

Ewald, P. P. Kristalle und Röntgenstrahlen [Book review] 156

Fairbanks, E. E. Lemberg's method 126

——— **Replacement xls,** 163

Ferrisymplesite (Walker, Parsons) 134

Fettke, C. R. Calcified log from W. Va. 67, 109

Fluorite, Rochester, N. Y. (Hawkins) 34

Foshag, W. F. 39

——— **and Gage, R. B. Hedyphane** 351

Foshagite, new silicate (Eakle) ...66, 97

Fossil bone (Rogers) 44

Friedel's law of intercepts (Rogers) 181

Fulgurite; N. J. (Myers, Peck) ..68, 152

Gage, R. B. Schallerite, new mineral 9

——— see Foshag, W. F. 351

Gap Mine; Pa. (Phemister) 44

Garnett, C. S 433

Genthite, N. Car. (Ross, Shannon) 444

Gesteins- und Mineralprovinzen. Band I. (Niggli, Beger) [Book review] 200

Gillson, J. L. Zircon, metamorphic mineral; Idaho 187

——— **and Shannon, E. V. Szaibelyite; Nev.** 137

Gladite (Johansson) 157

Goongarrite (Simpson) 39

Gordon, S. D. 132

Graphic tourmaline intergrowths; Maine. (Newhouse, Holden) .. 42

Grodnolite (Morozewicz) 134

Halloysite; Jones Falls, Md. (Shannon) 159

Hammarite (Johansson) 157

Harringtonite (Brauns, A., Brauns, R.) 202

Harrison, J.B. and Bourne, C.L.C. 333

Hawkins, A. C. Fluorite, Rochester, N. Y. 34

Headden, W. P. Smithsonite; N. Mex. 18

——— Stromeyerite; Col. 41

Hedyphane; Franklin Furnace. (Foshag, Gage) 351

Hematite crystal; Urals. (Syedelshchikov) 20

Hess, F. L. 40, 133

Heulandite 166

Heulandite, thermo-optical properties (Slawson) 305

Hoegbomite from Virginia (Watson) 1

Holden, E. F. Citrine, light transmission 127

——— **Color of smoky quartz and amethyst** 203

——— Temperature-pressure conditions of quartz formation ... 66

——— See Newhouse, W.H..... 42
Hornblende, basaltic; Hungary (Vendl).................... 202
Hovey, E. O., memorial of. (Whitlock)....................... 58
Hunt, W. F. [Book reviews]..... ....119, 200, 446

Iddingsite (Ross, Shannon)...... 448

Jakob, J.....................107, 108
Jamesonite; Idaho (Shannon).... 194
Jezek, B...................... 20
Johansson, K............157, 179, 180
Johnson, J. H. Table Mt. zeolites 118
Jolly balance, computing. (Kraus) 66

Kalithomsonite (Gordon)........ 132
Kalkowskyn (Rimann).......... 135
Kempite, new mineral (Rogers)... 39
Kerr, P. F. and Cabeen, C. K. Electrical conductivity of ore minerals.................. 66
Keweenawan minerals (Palache, Vassar.................. 412
Keyes, Charles. The crystule.... 15
Kossmatite (Erdmannsdöffer).... 448
Kratochvil, J.................. 20
Kraus, E. H., computing Jolly balance.................... 66
——— [Book reviews]....104, 105, 155
Kristalle und Röntgenstrahlen (Ewald) [Book review]....... 156
Kupferbürger, W. Danburite from La Sirena, Mexico........... 14

Landes, K. K. Pegmatites from Maine.................... 355
Larsen, E. S. Ectropite and Bementite.................. 418
——— see Gage............... 9
——— see Shannon, E. S........ 448
——— **and Schaller, W. T. Variscite and peganite and the dimorphous form, metavariscite**.................. 23
——— **and Vassar, H. Chalcoalumite, from Arizona**.......... 79

Lead, native (MacCarthy)....... 332
Lehnerite and ludlamite, identity of (Berman)............... 428
Lehrbuch der Mineralogie (Niggli) [Book review].............. 104
Lemberg's staining method (**Fairbanks**)..................... 127
Lindgren, W.................44, 133
Lindstromite (Johansson)....... 157

MacCarthy, G. R. Lead, native.. 332
Magnetite, from Spain (del Pan).. 21
Manca, E..................... 135
Martens, J. H. C. Barite in Genesee shale.............. 102
——— **Sulphate minerals of Ithaca, N. Y.**................ 175
McLintock, W. F. P. Petalite and Apatite.................... 202
Merrillite (Ross, Shannon)....... 448
Merwin, H. E, see Wyckoff, R W. G.................. 67
Metamorphism at Bingham (Lindgren)................ 44
Metavariscite.................. 23
Mica group (Winchell)..........52, 65
Mikroskopische Mineralbestimmung mit Hilfe der Universaldrehtischmethoden (Berek) [Book review]............... 105
Mikroskopische Physiographie der Mineralien und Gesteine (Rosenbusch-Wülfing) [Book review].................... 155
Mineralien der Niederrheinischen Vulkangebiete (R. Brauns) [Book review]............... 199
Mineralogical Society of America,
  Annual meeting............. 61
  election of officers and fellows. 61
  fellows.................... 69
  members................... 71
  nominations for officers....... 353
  papers read before........... 64
  proposed constitutional amendments................... 353
  report of committee on nomenclature, etc............... 64

report of editor for 1924...... 63
report of secretary for 1924... 61
report of treasurer for 1924.... 62
Minerals of Lukmanier Gorge (Weber)................... 21
Modern study of minerals (Washington).................... 45
Morozewicz, M. J............... 134
Mountain, E. D................ 202
Myers, W. M. and Peck, A. B. Fulgurite from N. J..........68, 152

Natrolite Group................ 112
Natural history of crystals (Tutton) [Book review]........... 446
Nelson, W. A.................. 434
Newark Mineralogical Society.... ....18, 38, 129, 178
Newhouse, W. H. and Holden, E. F. Graphic quartz-tourmaline intergrowths........... 42
New minerals, including doubtful species.................... 9, 79, 97, 107, 131, 157, 179, 201, 333
Newtonite, locality (Wherry)..... 350
New York Mineralogical Club.... ....36, 75, 105, 128, 177
Niggli, P. Lehrbuch der Mineralogie [Book review]........... 104
——— and Beger, P. J. Gesteins- und Mineral- provinzen [Book review].................... 200

Ondřej, A..................... 20

Palache, C. and Vassar, Helen E. Keweenawan minerals....... 412
Palladium amalgam (Harrison, Bourne).................... 333
Parry, J. and Wright, F. B....... 447
Parsettensite (Jakob)........... 107
Parsons, A. L..............21, 22, 134
——— see Walker, T. L.........66, 67
Peck, A. B. Andalusite, cyanite, sillimanite at high temps...... 253
——— see Myers, W. M........68, 152
Pectolite...................... 83
Peganite...................... 23
Pegmatites, central Maine (Landes)....................... 355
Petalite and apatite in aplite; Devonshire (McLintock)..... 202
Phemister, T. C................ 44
Philadelphia Mineralogical Society..................... 17,38,76,77,106,130,178-9,200
Phillipsite..................... 149
Prior, G. T.................... 433
Proustite; Ont. (Parsons)........ 21
Pumpellyite, new Mineral (Palache, Vassar).................. 412
Puxeddu, E.................... 135

Quartz crystals; Alps (Weber).... 21
Quartz, fibrous, and chlorite; R. I. (Richards)................. 429

Radio-detector minerals (Wherry) 28
Ramsdell, L. S. Crystal structure of metallic sulfides.........67, 281
——— [Book review]........... 155
Rauvite (Hess)................ 133
Reed, R. D., see Rogers, A. F..... 68
Replacement crystals, (Fairbanks).................... 163
Richards, G. Fibrous quartz and chlorite; R. I................ 429
Rickard, T. A.................. 21
Ries, H. Memorial of T. L. Watson....................... 54
Rimann, Eberhard............. 135
Rinne, F. Crystals and the fine structure of matter [Book review].................... 104
Rogers, A. F...................39, 44
——— **Friedel's law of intercepts**. 181
——— Crystallography of sucrose 67
——— Useful property of zones.. 68
——— and Reed, R. D. Sand calcite xls.................. 68
Rosenbusch-Wülfing. Mikroskopische Physiographie der Mineralien und Gesteine [Book review]............... 155
Ross, C. S., and Henderson, E. P. Topaz; Missouri......... 441

Ross, C. S., and Shannon, E. V. Bentonite and Montmorillonite 64
——— **Genthite; N. Car** 444
Rutile-ilmenite; Va. (Watson) 22

Sand calcite crystals (Rogers, Reed) 68
Saponite 412
Saxen, M. 180
Scapolite; Kanda (Baklund) 20
Schaller, W. T. 131
——— see Larsen, E. S. 23
Schallerite, a new mineral (Gage, Larsen, Vassar) 9
Schoep, A. 201, 131, 132
Schwartz, G. M. Xonotlite and pectolite, Minn. 83
Sericite 412
Shannon, E. V. 334, 448
——— see Gillson, J. L. 137
——— **Halloysite; Jones Falls, Md.** 159
——— **Jamesonite; Idaho** 194
——— **Re-examination of beaumontite** 31
——— see Ross, C. S. 64, 444
——— **Tetradymite; Idaho** 198
——— **Xonotlite; Leesburg, Va** 12
Sillimanite 253
Simpson, E. S. 39
Sincosite (Shaller) 131
Skeleton quartz (Bain) 435
Sklodowskite (Schoep) 132
Slavíková, L. 21
Slawson, C. B. Thermo-optical properties of heulandite 305
Smithsonite; Kelly Mine, N. M. (Headden) 18
Sodalite, evanescent pink. (Walker, Parsons) 66
Spencer, L. J. 202, 434
Stasite (Schoep) 201
Stoces, B. 20
Stromeyerite; Boulder Co., Col. (Headden) 41
Structure of crystals (Wyckoff) [Book review] 155
Sucrose, crystallography of (Rogers) 67
Sulphate minerals from shale; Ithaca, N. Y. (Martens) 175
Swedenborgite (Aminoff) 40
Syedelshchikov, V. V. 20
Szaibelyite, Lincoln Co., Nev. (Gillson, Shannon) 137

Table Mt. Colo. and its zeolites (Johnson and Waldschmidt) 118
Tellurides in Ontario (Thomson) 22
Tellurides (Rickard) 21
Temperature and pressure of formation of quartz (Holden) 66
Tetradymite from Idaho (Shannon) 198
Thaumasite, crystallization of (Eakle) 66
Thomson, E. 22
Thomsonite, pseudo-isomorphism (Wherry) 342
Thomsonite 90
Tinzenite (Jakob) 108
Torrás, L. 21
Topaz, Missouri (Ross and Henderson) 441
Tourmaline; Alabama (Van Horn) 348
Traversoite (D'Ambrosio) 108
Tutton, A. E. H. Natural history of xls [Book review] 446

Van Horn, F. R. Tourmaline from Alabama 348
Vanoxite (Hess) 40
Variscite and peganite, the dimorphous form, metavariscite (Larsen and Schaller) 23
Vassar, Helen. Clerici solution 123
——— see Gage, R. B. 9
——— see Larsen, E. S. 79
——— see Palache 412
Vendl, Miklos 202
Violarite (Lindgren and Davy) 133

Waldschmidt, W. A. Table Mt. and its zeolites 118

Walker, T. L. 41
——— and Parsons, A. L. 22, 134
——— Evanescent pink sodalite. 66
——— Characteristics of primary calcite 67
Washington, H. S. Modern study of minerals 45
——— see Wyckoff, R. W. G. 67
Watanabé, M. 22
Watson, T. L. 22
——— **Hoegbomite from Virginia** 1
——— **Memorial of, (Ries)** 54
Weber, L. 21
Wherry, E. T. Bentonite, a one-dimensional colloid 65, 120
——— Book review. 156
——— **Locality for newtonite**. . . 350
——— **Pseudo isomorphism in thomsonite** 342
——— **Radio detector minerals** . . 28
——— **Tabulation of aluminum silicates**. 65, 140
Whitlock, H. P. Memorial of E. O. Hovey 58
Winchell, A. N. Mica group 52
——— **Monoclinic amphiboles** . . . 335
——— **zeolites, composition of** 65, 88, 112, 145, 166
Wittite (Johansson) 179
Wright, F. G. 447
Wyckoff, R. W. G. Structure of crystals [Book review] 155
——— and Merwin, H. E. Space group of Diopside 67
——— Merwin and Washington, H. S. X-ray diffraction of diopside-like pyroxenes 67

Xonotlite and pectolite (Schwartz) 83
Xonolite, at Leesburg, Va. (Shannon) 12
X-rays and crystal structure (Bragg and Bragg) [Book review] 156

Yale Mineralogical Society 77

Zeolites, composition of (Winchell) 65, 88, 112, 145, 166
Zircon, a contact mineral, Idaho (Gillson) 187
Zones, property of (Rogers) 68